

Amendments to the Claims

This listing of claims will replace the originally filed claims in the application.

Listing of Claims:

Claims 1 – 25 (cancelled).

Claim 26 (new): A method which may be used for creating a mixture of hydrogen and carbon monoxide, said method comprising:

- a) producing hydrogen and carbon monoxide through a partial catalytic oxidation of at least one hydrocarbon with oxygen or a gas comprising oxygen, wherein said oxidation takes place:
 - 1) at a temperature less than about 1200 °C;
 - 2) at pressure between about 3 bar and about 20 bar; and
 - 3) in a first zone of a vessel;
- b) recovering a gas mixture from said partial oxidation, wherein:
 - 1) said gas mixture comprises hydrogen and carbon monoxide;
 - 2) said recovered gas mixture has a pressure between about 3 bar and about 20 bar; and
 - 3) said gas mixture rapidly enters a second zone of said vessel in less than about 100 milliseconds; and
- c) cooling said gas mixture by direct contact with pressurized water, wherein said gas mixture is cooled:
 - 1) in said second zone of said vessel; and
 - 2) to a temperature between about -20 °C and about 80 °C.

Claim 27 (new): The method of claim 26, wherein said cooled gas mixture has a pressure between about 3 bar and about 20 bar.

Claim 28 (new) The method of claim 26, wherein said gas mixture rapidly enters said second zone of said vessel in less than about 50 milliseconds.

Claim 29 (new): The method of claim 26, further comprising separating said cooled gas mixture to produce a hydrogen-rich gas stream.

Claim 30 (new): The method of claim 26, wherein said cooling comprises passing said gas mixture through a shower of pressurized water.

Claim 31 (new): The method of claim 26, wherein said hydrocarbon comprises at least one member selected from the group consisting of:

- a) natural gas;
- b) methane;
- c) ethane;
- d) a butane / propane mixture; and
- e) mixtures thereof.

Claim 32 (new): The method of claim 26, wherein:

- a) said hydrocarbon comprises methane or natural gas; and
- b) the CH₄/O₂ volumetric flow rate ratio is between about 1.2 and about 2.1.

Claim 33 (new): The method of claim 26, wherein said recovered gas mixture has a pressure between about 4 bar and about 20 bar.

Claim 34 (new): The method of claim 26, wherein said cooled gas mixture has a pressure between about 4 bar and about 20 bar.

Claim 35 (new): The method of claim 26, wherein oxidation takes place at a pressure between about 6 bar and about 12 bar.

Claim 36 (new): The method of claim 26, wherein said gas comprising oxygen further comprises nitrogen.

Claim 37 (new): The method of claim 36, wherein said gas comprising oxygen is air.

Claim 38 (new): The method of claim 26, wherein:

- a) a catalyst for said partial catalytic oxidation is formed by placing at least one metal on an inert support; and
- b) said metal comprises at least one member selected from the group consisting of:
 - 1) nickel;
 - 2) rhodium;
 - 3) platinum;
 - 4) palladium; and
 - 5) alloys thereof.

Claim 39 (new): The method of claim 26, wherein said recovered gas comprises:

- a) hydrogen in an amount between about 30% to about 40% by volume;
- b) carbon monoxide in an amount between about 15% to about 20% by volume;
- c) trace impurities, wherein said trace impurities comprise at least one member selected from the group consisting of:
 - 1) carbon dioxide;
 - 2) water; and
 - 3) C_nH_m type waste impurities; and
 - 4) mixtures thereof; and
- d) nitrogen in an amount to account for the balance of the volume.

Claim 40 (new): The method of claim 39, wherein said recovered gas comprises:

- a) hydrogen in an amount between about 31% to about 34% by volume; and
- b) carbon monoxide in an amount between about 17% to about 19% by volume.

Claim 41 (new): The method of claim 26, wherein said oxidation takes place at temperature between about 600° C and about 1090° C.

Claim 42 (new): The method of claim 41, wherein said oxidation takes place at a temperature between about 850 °C and about 1000 °C.

Claim 43 (new): The method of claim 29, wherein hydrogen-rich gas stream comprises at least about 80% hydrogen by volume.

Claim 44 (new): The method of claim 43, wherein said hydrogen-rich gas stream comprises about 99.9% to about 99.99999% hydrogen by volume.

Claim 45 (new): The method of claim 29, wherein:

- a) said cooled gas mixture is separated by a separation method;
- b) said separation method comprises at least one member selected from the group consisting of:
 - 1) a PSA separation method;
 - 2) a TSA separation method; and
 - 3) a membrane permeation separation method that uses at least one membrane module; and

- c) said separation generates:
 - 1) said hydrogen-rich gas stream; and
 - 2) a waste gas stream.

Claim 46 (new): The method of claim 45, further comprising generating electricity by sending said waste gas stream to a cogeneration unit.

Claim 47 (new): The method of claim 46, wherein said waste gas stream is sent to a boiler.

Claim 48 (new): The method of claim 26, further comprising removing at least part of the carbon dioxide and steam impurities from said gas mixture in order to produce a gas mixture with controlled amounts of hydrogen, carbon monoxide and nitrogen.

Claim 49 (new): The method of claim 45, wherein:

- a) said separation method comprises a PSA separation method;
- b) said PSA separation method comprises operating at least two adsorbers, wherein said adsorbers operate alternately; and
- c) when at least one said adsorber is in a regeneration phase, at least another said adsorber is in a hydrogen-rich gas stream production phase.

Claim 50 (new): The method of claim 45, wherein:

- a) said separation method comprises a TSA separation method;
- b) said TSA separation method comprises operating at least two adsorbers, wherein said adsorbers operate alternately; and
- c) when at least one said adsorber is in a regeneration phase, at least another said adsorber is in a hydrogen-rich gas stream production phase.

Claim 51 (new): The method of claim 45, wherein:

- a) said separation method comprises a membrane permeation separation method that uses at least one membrane module; and
- b) said modules produce:
 - 1) said hydrogen-rich gas stream; and
 - 2) a waste gas stream, wherein said waste gas stream comprises:
 - i) nitrogen; and
 - ii) carbon monoxide.

Claim 52 (new): The method of claim 51, wherein said waste gas stream further comprises hydrogen.

Claim 53 (new): The method of claim 30, wherein said cooled gas mixture is substantially free of soot.

Claim 54 (new): The method of claim 30, further comprising accelerating said gas mixture's passage between said first zone and said second zone with an accelerating means.

Claim 55 (new): An apparatus which may be used for preparing a gas mixture with controlled parts of hydrogen and carbon monoxide, said apparatus comprising:

- a) a partial catalytic oxidation reactor, wherein:
 - 1) a hydrogen and carbon monoxide gas mixture is produced in said reactor through a partial catalytic oxidation reaction between at least one hydrocarbon and oxygen or a gas comprising oxygen; and
 - 2) said reaction takes place:
 - i) at a temperature less than about 1200 °C; and
 - ii) at a pressure between about 3 bar and about 20 bar;
- b) a cooling means for cooling said gas mixture, wherein:
 - 1) said gas mixture is cooled by direct contact with pressurized water; and
 - 2) said gas mixture is cooled to a temperature between about -20° C and about 80° C; and
- c) a vessel, wherein said vessel comprises:
 - 1) said reactor;
 - 2) said cooling means; and
 - 3) an accelerating means, wherein said accelerating means:
 - i) is located between said reactor and said cooling means; and
 - ii) accelerates the passage of said gas mixture from said reactor to said cooling means such that the gas mixture transport time between said reactor and said cooling means is less than about 100 milliseconds.

Claim 56 (new): The apparatus of claim 55, wherein said gas mixture transport time is less than about 50 milliseconds.

Claim 57 (new): The apparatus of claim 55, wherein said cooling means comprises a shower of pressurized water.

Claim 58 (new): The apparatus of claim 55, further comprising a deflector means, wherein:

- a) said deflector means is located downstream of said cooling means; and
- b) said deflector means separates drops of water from said cooled gas mixture.

Claim 59 (new): The apparatus of claim 55, further comprising a cooling water supply and recirculation means.

Claim 60 (new): The apparatus of claim 59, wherein:

- a) said supply and recirculation means comprises a cooling water filtration system; and
- b) said filtration system filters solid particles in said gas mixture.

Claim 61 (new): The apparatus of claim 55, wherein said acceleration means comprises an inverted cone system.